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ABSTRACT

This report highlights the findings from research conducted to uncover what the nation's students think of the science education they are receiving, how they would improve it if they could, how they think they best learn science, and how they rate their parents and teachers when it comes to science. Data collection included an in-depth telephone survey on attitudes toward science and science education among a representative nationwide sample of young people age 10 to 17 (n=1,016). Students all across the country say that science is one of their favorite subjects in school. The appeal of science has to do both with its subject matter--which children find inherently interesting--and with the opportunities it allows for exploration and direct classroom participation. Students who learn about science through hands-on methods such as experiments and team problem-solving have far more favorable attitudes toward the subject than those who learn through traditional teaching methods such as lectures and textbook reading assignments. Students give their parents and teachers high marks for the parts they play in helping them learn science. Students credit their teachers with being enthusiastic, good at relating science ideas to everyday life, and providing clear, easy-to-understand explanations. (JRH)

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THE BAYER FACTS OF SCIENCE EDUCATION III:

A U.S. Student Report Card on Science Education

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Prepared for
Bayer Corporation

Prepared by
Peter D. Hart Research Associates

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INTRODUCTION AND METHODOLOGY

Between March 3 and 13, 1997, Peter D. Hart Research Associates conducted an in-depth telephone survey on attitudes toward science and science education among a representative nationwide sample of young people age 10 to 17. Sponsored by the Bayer Corporation in participation with the National Science Foundation's National Science and Technology Week 1997, the study includes interviews with a total of 1,016 youths (217 elementary school students, 372 middle school students, and 427 high school students). Overall, the poll has a margin of error of ±3.1%.

In late January, prior to designing and fielding the survey, Hart Research conducted two exploratory focus group discussions, one among kids age 11 to 13 and one among kids age 15 to 17, in Fairfax County, Virginia, a suburb of Washington, DC.

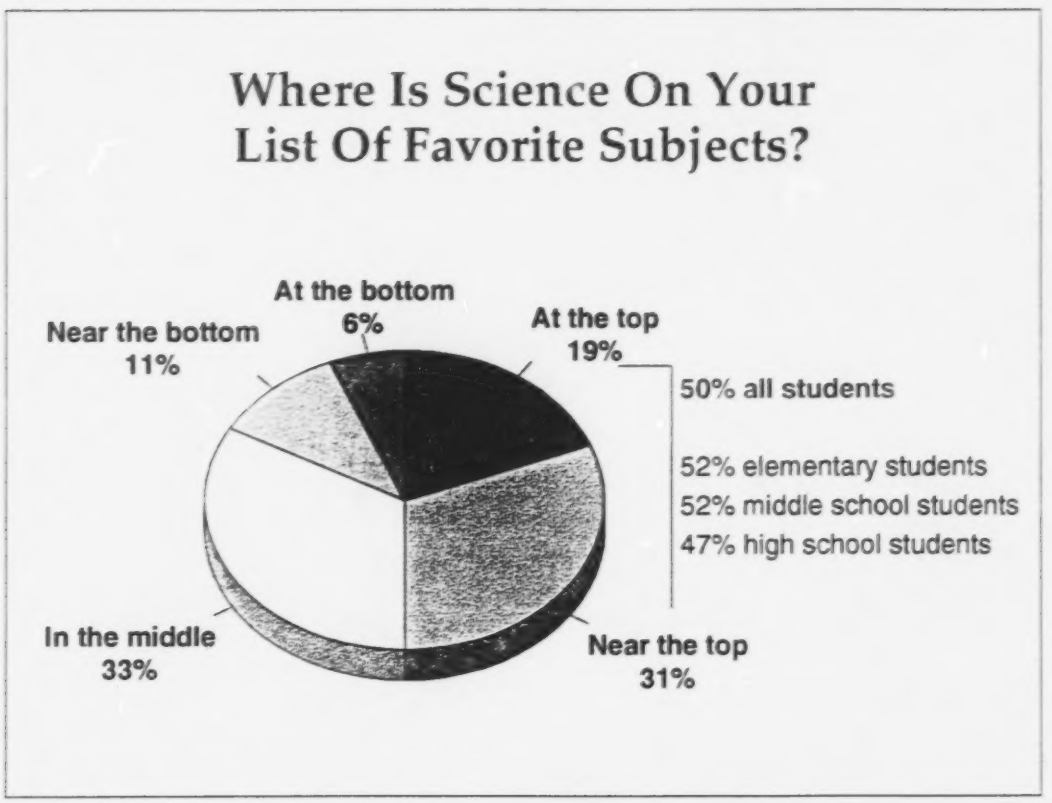
The goals of the research were to uncover what the nation's students think of the science education they are receiving, how they would improve it if they could, how they think they learn science best, and how they rate their parents and teachers when it comes to science.

This brief report highlights the principal findings that emerge from the research.

STUDENTS' INTEREST IN SCIENCE EDUCATION

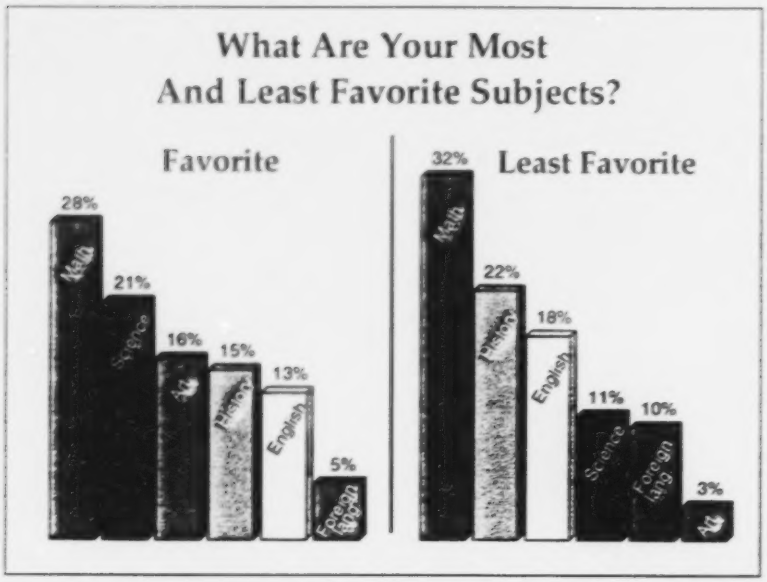
Students all across the country say that science is one of their favorite subjects in school these days. The strong appeal of science has to do both with its subject matter, which kids find inherently interesting, and with the opportunities it allows for exploration and direct classroom participation.

Half of all 10- to 17-year-olds rank science at or near the top of the list of the subjects they like the most; a third put it somewhere in the middle, and fewer than one in five place it at or near the bottom of the list. The level of enthusiasm for science is nearly equal among elementary, middle school, and high school students.


Where Is Science On Your List Of Favorite Subjects?
At the bottom 6%
At the top 19%
Near the bottom 11%
50% all students
52% elementary students
52% middle school students
47% high school students
In the middle 33%
Near the top 31%

In their own words, kids say that what they like best about science has to do with scientific techniques – such as experiments, lab work, and dissection – and with specific scientific topics – such as astronomy, the human body, chemistry, and nature. There is little that young people indicate that they *don't* like about science;

their objections tend to be largely generic and could apply to any subject (dislike of a particular teacher, of taking notes, doing book work, or taking tests).



Science also stands out when it's stacked up against other subjects, including the Three Rs, history, art, and foreign language. Twenty-one percent of 10- to 17-year-olds choose science as their favorite subject – making it the second most popular class, just behind math (28%), but ahead of art (16%), history (15%), English (13%), and foreign language (5%) – and only 11% say it's the subject they like least. Math, on the other hand, tends to be a polarizing subject, with as many detractors as fans.

Science's popularity has much to do with its ability to stimulate young people's curiosity and maintain their interest through *doing* and not merely being passive listeners (it clearly is not a "boring" subject, from kids' point of view; history, math, and English vie that for distinction).

Science also appeals regardless of the fact that kids don't find it their easiest class and don't necessarily get their highest grades in science. *This suggests that their interest in science is not inextricably linked to their ability to succeed in it academically, but may relate more to the enjoyment that they derive from it.*

Contrary to the conventional stereotype that science may be more for boys than for girls, feelings toward it do not differ noticeably by sex. Girls are just as likely as are boys to rate science at or near the top of their list of subjects, equally likely to select it as their favorite subject, and just as unlikely to choose it as their least favorite subject. Girls are almost as prone as are boys to say that science is the coolest subject and that it is the class in which they get to participate the most. And interestingly, girls are even more likely than are boys to say that it is the subject about which they are most curious.

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For You, What Subject Is . . .

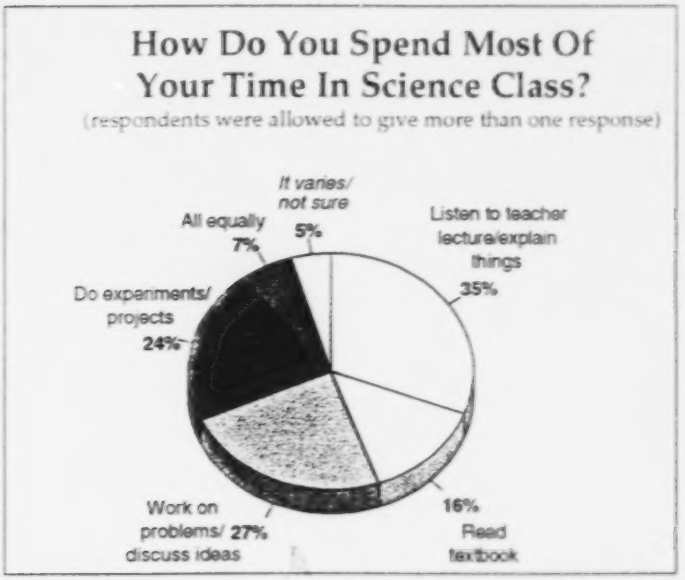
	Science	Math	History/ Social Studies	English
the one you are most curious about?	42%	13%	33%	7%
the coolest?	36%	21%	21%	15%
the class where you get to participate the most?	31%	21%	19%	20%
the class in which you get your best grades?	20%	32%	23%	20%
the most difficult to understand?	21%	36%	22%	14%
the most boring?	14%	27%	29%	24%

SCIENCE IN THE CLASSROOM

Students who learn about science through hands-on methods, such as experiments and team problem-solving, have far more favorable attitudes toward the subject than do those who learn through traditional teaching methods, such as lectures and textbook reading assignments.

This study explores the experiences and opinions of students from elementary school through high school, and from grade level to grade level, kids learn about science differently. Among elementary school kids, seven in ten have the same teacher for science as they do for all other subjects, and eight in ten have science in a regular classroom. While half are studying science every day, just over one in four are studying it three or four days a week, and one in five are studying it two days a week or less. Their older counterparts, middle school and high school kids, tend to study specific scientific disciplines, such as chemistry, physics, and biology, and half of them say they have science in a lab rather than in a regular classroom with no special equipment. Elementary school students work primarily

alone at a desk or in a team, while older kids also work in teams, but are much more likely than are elementary school students to have a lab partner.


How Do You Spend Most Of Your Time In Science Class?
(respondents were allowed to give more than one response)
It varies/ not sure 5%
All equally 7%
Listen to teacher lecture/explain things 35%
Do experiments/ projects 24%
Work on problems/ discuss ideas 27%
Read textbook 16%

As students describe the sometimes varied ways in which they spend their time in science class, their report suggests that roughly half of students learn about science mainly by the traditional means of listening to the teacher lecture or reading from a textbook, while the other half learn chiefly through more hands-on methods, such as doing experiments or discussing problems.

When it comes to science, the teaching approach is critical; the method of instruction students experience is the primary catalyst that influences their overall attitudes toward their science education. Indeed, the enjoyment many kids derive from getting the chance to participate in an interactive, "hands-on" way in their science class is one of the most significant findings of this study.

We do a lot of hands-on work instead of just sitting and listening and trying to learn it all. You get to do the hands-on and see what it's like to make the projects.

Maureen, age 11, 6th grade

In my other classes, we sit down the whole time; we don't get up and move around and stuff. So in science, we move all over the classroom and sometimes, a lot of times, we're not even in the classroom. So I think that's why it's fun.

Chrissy, age 13, 7th grade

Though there are few demographic differences between students who learn science through hands-on methods and those who study it in the traditional way, the classroom environment of the two groups is different in three major ways. First, 59% of "hands-on" students give their teacher an "A" for overall performance, 15 percentage points higher than the proportion of "traditional" learners who award that high mark. Second, a majority of students who learn through traditional methods have class in a regular classroom and are fairly evenly divided in whether they work alone, with a partner, or on a team. Hands-on students, in contrast, are just as likely to have class in a lab as in a regular classroom, and they most often

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work in teams. Finally, consistent with the definition of hands-on, students in this type of setting are twice as likely as are those in a traditional classroom to say that they personally get to conduct experiments every time or a lot of the time when they have science class.

Students' vastly different experiences in the classroom produce a sizable gap in their attitudes toward science. As the following table shows, there is an average difference of eight points between the hands-on and traditional groups on measures that gauge kids' general attitudes toward science and their overall impressions of science compared to other subjects.

HANDS-ON VS. TRADITIONAL METHODS: A COMPARISON OF FEELINGS ABOUT SCIENCE				
	All Students %	Hands-on %	Traditional %	Differential ±
GENERAL ATTITUDES TOWARD SCIENCE				
Science at the top of the list/near the top of the list of subjects they like	50	54	45	+9
Consider themselves excellent or very good science students	37	40	32	+8
Science is their favorite subject	21	24	17	+7
IMPRESSIONS OF SCIENCE COMPARED TO OTHER SUBJECTS				
Science is the class in which you get to participate most	31	38	25	+13
Science is the coolest subject	36	40	31	+9
Science is the subject you are most curious about	42	45	39	+6
Science is the one subject you get the best grades in	20	22	16	+6
Science is the most difficult subject to understand	21	18	23	-5
Science is the most boring subject	14	9	19	-10

The disparity in attitudes between these two groups of students, as well as students' repeated assertion that one of the things that makes science special is the ability to participate directly in class, suggests that a more widespread use of hands-on inquiry methods in the science classroom may be a useful step toward improving students' feelings toward science. This sentiment was found to be shared by teachers, principals, and business executives in the previous Bayer Facts of Science *studies.*

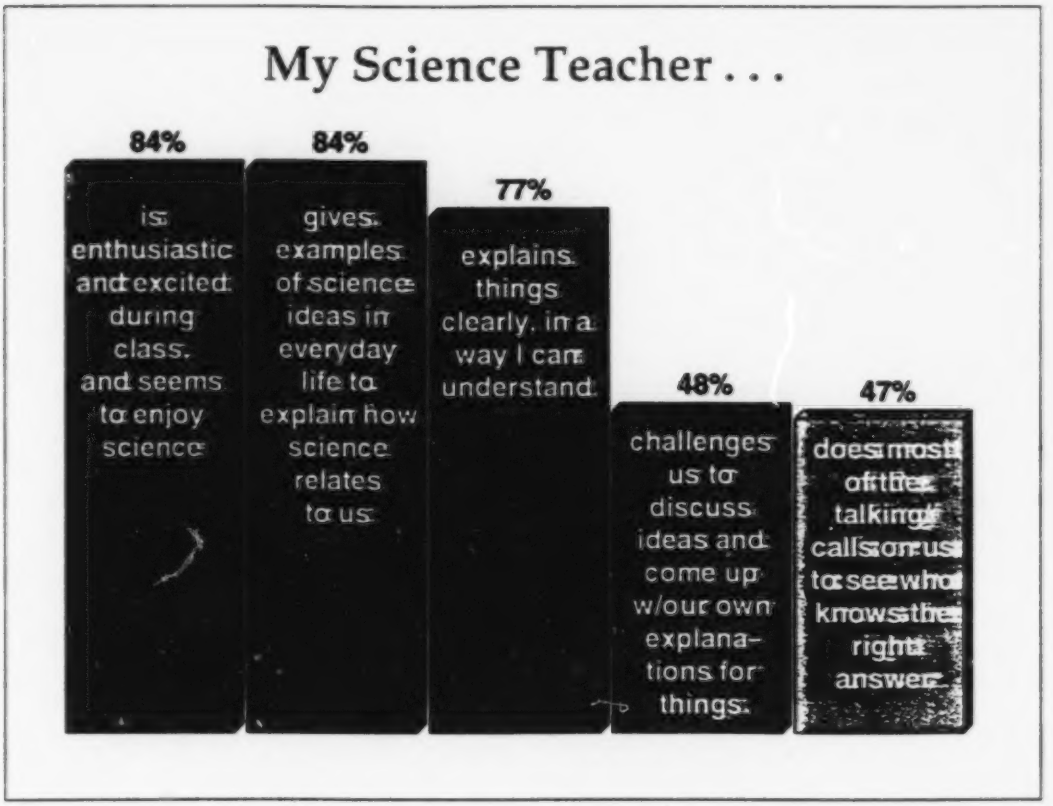
THE ROLE OF PARENTS AND TEACHERS

Students give their parents and their teachers high marks for the part they play in helping them learn science. Young people's general appreciation of these adults' roles stands in contrast to parents' and teachers' more downbeat self-assessments, however. This dichotomy suggests that it may not be "hard knowledge" so much as enthusiasm and encouragement and intellectual stimulation from their teachers and parents that young people are looking for and respond to.

In *The Bayer Facts of Science Education, Part I* – a survey that examined the views of parents and teachers of elementary school students – both groups questioned their own abilities to help students. While seven in ten teachers said that they believe that schools should increase the level of science education, only about half that proportion claimed to feel "science-literate," and many expressed the belief that they are less qualified to teach science than to teach other subjects. Similarly, a solid majority of parents acknowledged that science education is important, and virtually all moms and dads expressed a desire to help their kids more with it at home, but just a third considered themselves science-literate.

From the view at *their* desks, however, kids give their teachers solid grades for the job they are doing in teaching science: 52% "A"; 32% "B"; 10% "C"; and only 5% "D" or "F." These results vary by grade level, as elementary school kids (66% "A") are more likely to give their teachers the highest grade than are middle school (53% "A") or high school students (42% "A"). In every demographic group, though, at least seven in ten students give their teacher a "B" or better.

Specifically, students credit their teachers with being enthusiastic, good at relating science ideas to everyday life, and providing clear, easy-to-understand explanations.


My Science Teacher . . .
84%
is enthusiastic and excited during class, and seems to enjoy science
84%
gives examples of science ideas in everyday life to explain how science relates to us
77%
explains things clearly, in a way I can understand
48%
challenges us to discuss ideas and come up w/our own explana-tions for things
47%
does most of the talking & calls on us to see who knows the right answer

Students give teachers less credit for their basic instructional approach. Ten- to 17-year-olds are divided over whether they would describe their teacher as someone who challenges students to discuss ideas and come up with their own explanations or as someone who does most of the talking in class and calls on students to see who knows the answer. Interestingly, 60% of those who say that science is their favorite subject describe their teacher as the kind who challenges them, compared to only 30% of those who say that science is their least favorite subject. Kids' desire to be challenged is consistent with their interest in hands-on rather than traditional science, and it suggests a need for students to feel empowered rather than restricted by their teachers.

Young people's evaluation of their parents' role in their science education is at once in agreement with and in opposition to the prior Bayer study. Consistent with the emphasis that parents said they place on science, fully nine in ten elementary school students and more than eight in ten middle school and high school students report that their parents consider science to be a very or pretty important subject for them to be learning. Contrary to parents' self-appraisal, however, kids give their folks good marks when it comes to being able to help them. Sixty-four percent of all students award their parents an "A" or "B" when it comes to being able to help, 21% give them a "C," and 11% offer a

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grade of "D" or "F." There is a sharp drop-off in the proportion of students who give their parents an "A" or "B" from elementary (84%) to middle school (67%) to high school (49%), which may be due to older students' increased independence and decreased inclination to ask parents for help, the increased difficulty and sophistication of their science studies, or both.

MAKING SCIENCE BETTER

Science comes naturally to kids. Whether it's surfing the 'Net or scanning the stars through a telescope, studying animal behavior or working to solve a real-life community problem, young people demonstrate an interest in "back yard science." To the extent that their experiences in the classroom build on this affinity – by emphasizing exploration and discovery, by allowing students to indulge their curiosity, and by challenging them to think critically and independently – science education is at its most effective and engaging.

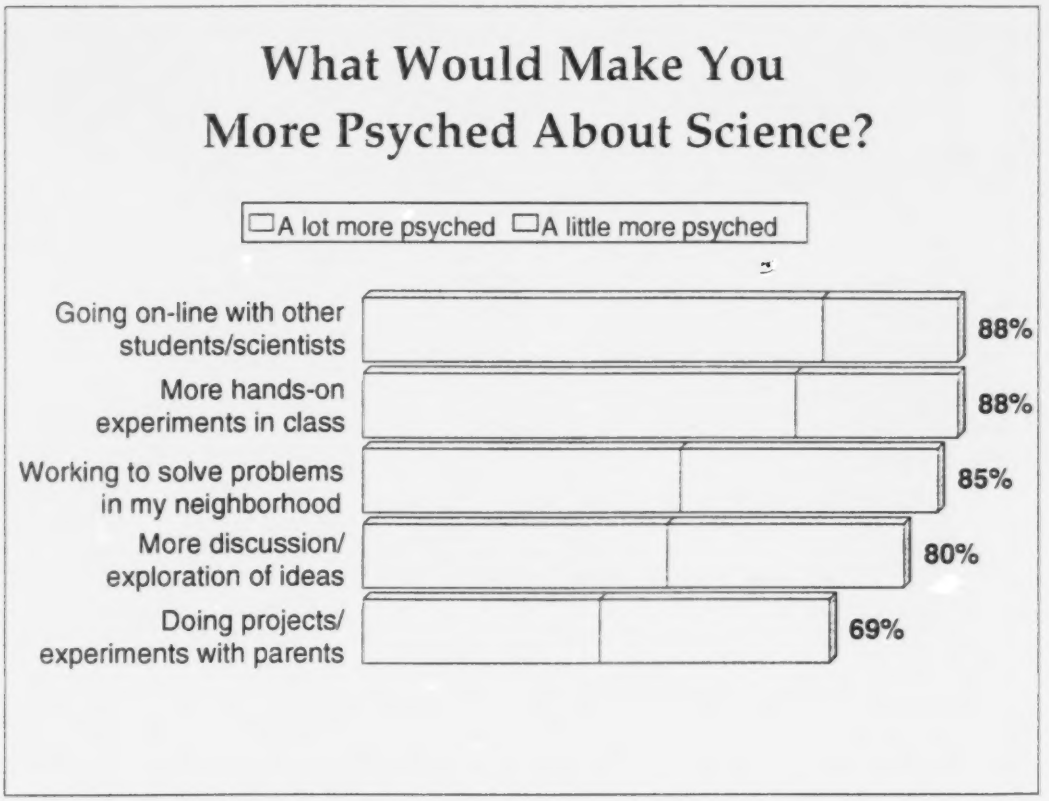
The information technology revolution may play a key part in connecting more kids to the kinds of scientific learning opportunities they enjoy and respond to most. Put simply, computers and kids go together. There's a personal computer in two of every three households with kids age 10 to 17, and just over three in five of these youngsters say they use that PC regularly – either daily or a few times a week. Nearly eight in ten kids assert that, if they could have a few extra hours every weekend to do something new, they'd have a lot of interest or pretty much interest in learning how to explore the Internet on a computer. And two-thirds say that they'd be a lot more "psyched" to get into science if they could use a computer to go on-line and communicate with other students and scientists.

Cyberspace isn't the only realm that excites youngsters, however. Substantial numbers of kids report that they'd be interested in using spare weekend hours to go to parks or different natural habitats to observe wildlife and animal behavior (63%) or to use a telescope to study the planets and stars (57%).

As important as *what* kids are learning about science is *how* they are given the opportunity to learn. In their own words, 10- to 17-year-olds most frequently suggest that doing more experiments (either in school or at home), more lab work, and having more hands-on experience would help bring out the fun and exciting parts of science for them. They recommend, as well, that taking more field trips and showing them how scientific concepts apply to their everyday lives and activities would make learning about science better.

Beyond offering their own advice, kids respond very favorably to a number of other suggestions for increasing their interest in science. At least seven in ten

students identify five different ideas as things that would make them more psyched about learning science, including two – using a computer to go on-line and communicate with other students and scientists, and doing more hands-on experiments that students conduct in class themselves – that more than three in five say would make them *a lot more psyched* about science.



Perhaps the clearest evidence of the power of these steps that could be taken is that those students who currently report that science is their *least* favorite subject are just as likely as are kids overall to say that four of these steps would make them a lot more psyched to study it. This potential shift in attitudes implies that the tools exist with which a great deal of progress could be made toward enhancing or capturing the interest and enthusiasm of even those youngsters who haven't yet been turned on to science.

Youngsters' reactions to their current science learning experiences tell a story of what's working and what is not working in science education today. For the nation's educators, policymakers, and citizens as a whole, the significance of what teachers, parents, school administrators, business leaders, and now students themselves have revealed regarding the teaching and learning of science is clear. All

these stakeholders agree, from their varying perspectives, that science literacy is now and will become even more important in the future. Like the adults surveyed in the previous *Bayer Facts of Science* studies, a majority of today's students believe that science will be more important for the next generation of kids who will start school 10 years from now (61% overall, including half who say that it will be *much* more important).

America's young people have demonstrated that they like science, enjoy flexing their minds and imaginations through scientific inquiry, and recognize that science is part of the world around them. Given the chance to pursue their interests through more hands-on learning, both inside and outside the classroom, today's students will be well-equipped to be lifelong learners, and may become tomorrow's scientists and engineers as well.